a triangular black flag, for temperature, to be hoisted above the other flag for higher temperature, below for lower temperature; and a square white flag, with square black centre, for a cold wave, as at present. When suspended from a horizontal pole or rope, a small white streamer will be used to indicate the end from which the flags are to be read. This system of signals is superior to the Ohio system, — red and blue, sun, star, moon, — now in general use, by reason of its simplicity, visibility, and cheapness; and the absence of red among its colors removes the objection that many railway managers have felt to the display of the other signals on the sides of cars.

THE FALL MEETING OF THE NATIONAL ACADEMY.

THE semi-annual meeting of the National academy of sciences was held Nov. 9–11, 1886, in Boston. By the kindness of the Massachusetts institute of technology, the academy was accommodated in its spacious buildings on Boylston Street. More than half the members of the academy were present, the number being larger than usual, owing to the interest taken by many in the two hundred and fiftieth celebration of the founding of Harvard college, which event was celebrated on the preceding days. The only business of general interest related to the publication of the annual volumes of memoirs. The president announced that the text of vol. iii. was nearly all printed, and that authors are cautioned to see that the manuscript and illustrations are always in proper shape, and complete for the printer when handed in to congress early in December of each year, as otherwise they are likely to be rejected. Of the scientific papers read, a full list of which is given on another page, we note the following: —

S. P. Langley, in a paper on 'The solar-lunar spectrum,' stated that for some years past we have suspected, but never actually been able to demonstrate, the existence of radiations from the sun of wave-lengths greater than three microns, and have been in doubt whether our atmosphere had entirely absorbed these if they really existed, or whether they were absorbed already in the sun's atmosphere and never reached ours at all. He has during the last year shown that the former hypothesis is more probable, and that the trouble lay partly in the fact that the terrestrial absorption here was almost total; partly in the apparatus, wherein diffused solar radation of shorter wave-lengths entirely obscured the almost infinitely feeble portion of these longer waves, which our atmosphere had in fact transmitted. By the use of very perfect rock-salt trains, and by an elaborate device for sifting out extraneous radiations, he has now been able to show the existence of certain of the longer solar waves, even down to the extreme length of seventeen microns, to which waves lamp-black is as transparent as glass is to the shorter or light waves. This selective absorption of lamp-black has been before surmised, but its existence to this degree is a new fact. On examining the radiation of the moon, Langley finds, in spite of the feeble heat, some of these long waves more easily distinguished than in solar radiation, owing to the fact that in the case of the moon, whose radiation, he observes, is mainly dark heat of these very great wave-lengths, he is not troubled with the enormous disturbances due to the diffusion of the intense shorter waves in the case of the sun. He states then that there is found, by the aid of the rock-salt trains, a minute amount of solar heat between three and five microns, below which the cold bands which have been growing closer and closer, and letting less and less heat between them, practically coalesce into one almost unlimited cold band, extending to eleven microns; and that probably the earth's atmosphere absorbs practically all the solar radiation between five and eleven microns, and, indeed, beyond; except that there is one band of most feeble transmission from this point to about sixteen microns. This transmission is here so feeble that the energy of the strongest radiations in this latter part of the normal spectrum is less than one one-thousandth of that in the visible region, and the total radiation here even less in proportion to that in regions already known.

These new researches, then, while enlarging the extent to which the solar infra-red spectrum has been examined, to the great probable length of over seventeen microns, and while confirming the previously announced fact that almost no solar heat reaches us in this region, are chiefly interesting in their bearing on the question of the transmissibility of our atmosphere, and as showing that its apparent action in allowing lunar heat to pass where no solar heat was found is consistent with the possible existence of the latter, outside our atmosphere, of every wave-length. Professor Langley's researches on lunar heat are not completed, but he announced the conclusion as probable that the temperature of the moon's sunlit surface is neither as high as assumed by Lord Rosse nor as low as he himself was once inclined to think, and probably may be little higher than that of melting ice.

T. Sterry Hunt read a paper on 'A basis for chemistry.' Herein he resumed the conclusions of a series of papers on chemical philosophy from 1848 to 1886. He defined chemical changes as interpretation or differentiation resulting in new species; distinguished in the chemical process metagenesis and metamorphosis, the latter embracing homogeneous changes only; sought to define the limits between chemistry and dynamics, and to exclude the atomic hypothesis from the former; discussed the genesis of chemical species from a primal element; maintained that not only solution but fusion, solidification, volatilization, and condensation are chemical processes, liquid and solid species being polymers of their respective vapors; and showed that the law of homologous or progressive series extends to mineral species, as oxides and silicates, which are not only of high equivalent weights and complex formulas, but are polymers whose degree of condensation it is possible to fix. The values got by dividing the received equivalents (hydrogen being unity) by the density (water being unity) represent, not the volumes of molecules, but the contraction in passing from the gaseous to the solid or liquid state, being the reciprocals of the coefficients of condensation. Water, whose density at $+4°$ is 1.000 (being formed by the condensation of 1,628 volumes of steam at 100°, with an equivalent weight of 17.9633, to a single volume at the same temperature), has itself an equivalent weight of 29.244 instead of 29.304 (which corresponds to $H_2O = 18$), as given by the author in *Science* for Sept. 10, 1886. From this figure the equivalent weights of all spheres whose specific gravities are known may be calculated; the law of volumes being universal, and extending alike to gases and vapors, to liquids and solids.

F. W. Putnam, in a paper on 'Archeological explorations in the Little Miami valley,' illustrated by elaborate drawings and photographs, showed that the exhaustive method adopted during the past five years is the only one that can possibly give results of any value relative to the early occupants of this continent. Professor Putnam's researches show that there have been at least two types of people, — first, those whose graves are the so-called ash-pits; second, those who built great mounds over the remains of their chiefs and great leaders, while the mass of the common people were buried in trenches lately discovered by him. Both these occupied the central regions, and were spreading northward when they were met and overthrown by the Indian races of modern times, who have spread from east to west. Professor Putnam's paper was but a small selection from the large volume now preparing by him.

E. C. Pickering read a paper on the 'Draper memorial photographs,' in which he stated that photographs of the spectra of the stars had been studied by himself first with a small telescope, the exposures lasting generally five minutes, next with a larger telescope, and finally with the magnificent eleven-inch glass belonging to Dr. Draper, and loaned by his widow, in front of which are placed two wedges or prisms of glass eleven inches square, and whose construction must be considered as the greatest triumph hitherto attained by the opticians. With this latter apparatus, which has now been in operation only a few weeks, photographs of the stellar spectra have been made by exposures of from five minutes up to one hour. The bright and dark lines in these photographs, as shown by high magnifying powers, are to be counted by hundreds testifying to the wonderful perfection of the optician's work, and give us for the first time assurance that the problem of the movement of the fixed stars to and from the earth can now be attacked with hopes of success. By means of the lantern, Professor Pickering showed upon the screen the result of some of his most recent photographs, among them the entire group of the Pleiades, in which the agreement among the spectra of certain stars strongly confirmed the results announced by Dr. Elkins as to their physical connection.

C. Abbe, in a paper on 'The question of barometer exposure,' stated that the influence of the wind upon the barometer is not a new question, but has long since been recognized as an important matter. Its actual treatment had, however, been so difficult as to lead to its neglect. This is one of a series of difficult questions in aerodynamics which are intimately connected with each other. For instance: the rain-gauge is an obstacle to the wind; the currents about its mouth deflect the rain; the proper gauge must be so constructed that there shall be no currents about its mouth; the best gauge has the least deflection. On the other hand, a cowl on a chimney-top to increase the draught or ventilation is an obstacle to the wind, so arranged that it shall give the greatest disturbance: its province is to diminish the static pressure at the top of the chimney, and allow the static pressure in the room below to push the air upward. Elaborate experiments on this subject were made in Boston in 1848, and the apparatus is still preserved by the chairman of the committee, Dr. Morrill Wyman: illustrations of their results were given by the author. The problem of measuring the force of the wind is very distinct from that of measuring the velocity, since the force varies with the shape of the obstacle and its size. Illustrations of

various apparatus and results were given. If now a barometer could be carried along with the wind, it would indicate the static pressure within that mass of moving air; but as soon as the barometer is fixed, it, or the building within which it is contained, becomes an obstacle, and a dynamic effect is added to the static pressure. A barometer on the windward side of an obstacle gives too high, and on the leeward side too low, a result. Our only practicable method of determining the static pressure is to measure these two compound results relative to any obstacle, and then from theory or experiment obtain a third relation between the two dynamic effects, whence by elimination we find the separate items. The author showed the application of this idea to the apparatus of Pitot, Darcy, Arson, and, further, that the simplest solution consisted in exposing a sphere as the obstacle, and measuring the pressures shown by barometers that are connected by small tubes with the windward and leeward sides of the sphere, the sphere being chosen as one of the few bodies whose stream lines have been satisfactorily determined by mathematical analysis.

Alfred Russell Wallace read a paper on 'The wind as a seed-carrier,' in which he stated that he would by request submit some ideas and ask for data in relation to the ability of the winds, to explain the known distribution of plants. He stated that a large number of arctic plants are now widely distributed throughout the southern and northern hemispheres, so that plants living in New Zealand, Australia, and extreme southern America, are nearly identical with those in high northern latitudes, as also with those found on the high mountains of temperate zones. These occurrences might be explained by the glacial epoch, as Darwin suggested, but that no such glacial epoch is known to have occurred in the torrid zone. His own studies on the fauna of the islands of the ocean had shown that a single occurrence, under favorable auspices, could explain the introduction of a new species in any out-of-the-way place, as illustrated by transfers of seed by sea-currents, by birds in various ways, by human agencies, and especially by the wind. Strong winds carry the heavier seeds short distances, and drop them, to be lifted up and carried again on some future occasion; but the lighter seeds, when once elevated, fall so slowly that even a moderate wind will carry them to great distances. In this way the arctic fauna may be easily transferred toward the torrid zone, and possibly an occasional storm (even one in a century will suffice) may transfer the seeds across the equator, so as to initiate the spread of the same species in the southern hemisphere.

THE HARVARD CELEBRATION.

Two hundred and fifty years ago on the 7th of November, 1636 (new style), the great and general court of the Massachusetts Bay colony agreed to give four hundred pounds towards a college or school. That vote was the founding of Harvard university,— a foundation which was, to use Mr. Lowell's words, "a quite unexampled thing." "Surely," he added, "never were the bases of such a structure as this has become, and was meant to be, laid by a community of men so poor, in circumstances so unprecedented, and under what seemed such sullen and averted stars. . . . The prevision of those men must have been as clear as their faith was steadfast. Well they knew and had laid to heart the wise man's precept, 'Take fast hold of instruction; let her not go, for she is thy life.'"

The anniversary exercises began on Friday, when the law school alumni listened to an address from Oliver Wendell Holmes the younger, and then dined together. Saturday was devoted to the undergraduates, — literary exercises and a boat-race in the morning, with a foot-ball game in the afternoon. The torch-light procession assigned for the evening of this day was postponed to the following Monday. Sunday the true anniversary of the foundation was divided between two services in the college chapel, in which Presidents Dwight and McCosh assisted Phillips Brooks and the university pastor, F. G. Peabody. Sandwiched in, as it were, between these sacred services, was a concert by the Boston symphony orchestra.

But Monday was the interesting day, the most notable event of which was the splendid oration delivered by James Russell Lowell, a graduate of and a professor in Harvard college. The theme was one to inspire any orator, and what an audience was gathered to hear him! The alumni were out in force, and filled every nook and corner of Sanders theatre, while on the platform was an assemblage of distinguished men such as one seldom sees. First and foremost among the invited guests was the President of the republic; and the enthusiasm with which Mr. Cleveland was greeted showed that Harvard men appreciate true manliness. With him were Secretaries Bayard, Lamar, and Whitney, while Endicott occupied his chair as a fellow of the corporation. When the conferring of honorary degrees was reached, the name of Lamar was found to be second on the list, and the demonstration which greeted the announcement was very marked. Among educators should be mentioned the delegate from John Harvard's college, Emmanuel, and from his university, Cambridge. In truth,

Cambridge was the mother of the New England university, while from Emmanuel came many of the most illustrious of the founders of Massachusetts. College presidents, too, were numerous; among the rest, Dwight of Yale, Gilman of Johns Hopkins, Angell of Ann Arbor, McCosh of Princeton, Adams of Cornell, and the youthful head of old Bowdoin, William De Witt Hyde, of the Harvard class of 1879. The degree of doctor of laws was conferred on most of those who had not already received it, and also on Leidy of Pennsylvania, Charles Deane of Cambridge, and Gildersleeve of Baltimore.

Mr. Lowell's oration contained that happy mixture of wit and scholarly wisdom so essential to an interesting address. As an example of this, was the remark that the college buildings, unlike those of the old country, never looked old, and never would. "Time refuses to console them," he said. "They all look as though they meant business, and nothing more. And it is precisely because this college meant business, — business of the gravest import,— and did that business as thoroughly as it might with no means that were not niggardly, except an abundant purpose to do its best, — it is precisely for this that we are gathered to-day." Further on, after describing the Puritan society of the early time, Mr. Lowell said, "It was a community without charm, or with a homely charm at best, and the life it led was visited by no muse, not even in dream; but it was the stuff out of which fortunate ancestors are made, and twenty-five years ago their sons showed in no diminished measure the qualities of the breed." But the portion that aroused the most enthusiasm was at the close, when he referred to the President of our country. "We have no politics here," he said, "but the sons of Harvard all belong to the party which admires courage, strength of purpose, and fidelity to duty. . . . He has left the helm of state to be with us here; and so long as it is intrusted to his hands, we are sure, that, should the storm come, he will say with Seneca's pilot, 'O Neptune, you may save me if you will, you may sink me if you will; but, whatever happens, I shall keep my rudder true.'" Coming after this oration, Dr. Holmes's poem proved disappointing to many.

In the afternoon the alumni dined in the great hall, and, after satisfying the inner man as well as they could, they listened to more speeches. Especially deserving of remembrance was that of President Angell of the University of Michigan. In brief he declared that all American colleges were indebted to Harvard for "her brave experimentations in college and university problems. . . . Especially under the present vigorous administration, there have been such exhaustive study and such courageous experimenting, that the excitement and stir have reached the remotest country college and the most secluded village academy. . . . This has made an epoch. Never before did the college and the people get so near together. Those who do not accept the doctrines in favor here, and those who do, are alike indebted to you, for we have all been stirred."

While the men were thus passing their time, Mrs. Eliot was introducing Mrs. Cleveland to the ladies of Cambridge. In the evening a public reception was held in the Hemenway gymnasium, and the festival so happily conceived and so admirably conducted was brought to a close. Indeed, perhaps not the least fruitful part of the whole celebration were the social relations which were begun or continued in the hospitable parlors of the college town.

NOTES AND NEWS.

THE semi-annual meeting of the trustees of Princeton college last week was the occasion for the presentation of a report on the state of the college by President McCosh. This year the college has more students than any previous year in its history. Eighty-nine graduates are attending classes, fifty of whom follow Dr. McCosh's lectures on contemporary philosophy. The trustees adopted a scheme similar to that in operation at Amherst and Harvard, by which the students choose a standing committee to represent them in conferences with the faculty. This plan goes into effect at once. The plans of President McCosh looking to the transformation of the college into a thoroughly equipped university were listened to with approval, and referred to a special committee consisting of the standing committee on curriculum and two other members of the board of trustees.

— The following is a complete list of the papers entered to be read before the National sciences academy at the recent session in Boston, Nov. 9–11: S. P. Langley, The solar-lunar spectrum; T. Sterry Hunt, A basis of chemistry; Alpheus Hyatt, Primitive forms of Cephalopoda; Alpheus Hyatt, A case of evolution in the migration of forms; Alpheus Hyatt, Lituites of the limestones of Phillipsburg, Canada; F. W. Putnam, Archeological explorations in the Little Miami valley, Ohio, conducted by F. W. Putnam and C. L. Metz; E. C. Pickering, Draper memorial photographs; E. D. Cope, On lemurine reversion in human dentition; E. D. Cope, On the columella auris of the tailed Batrachia; Edw'd S. Morse, Change in Mya since the pliocene; A. S. Packard, The cave